

Notes

Users of the L1B product are strongly encouraged to use the actual Relative Spectral Response values (RSR). Revision B of these is located at : **anonymous ftp site mcstftp.gsfc.nasa.gov, in /incoming/MCST/PFM_L1B_LUT_8-3-98 directory.**

Further direction may be found in the Readme file in that directory .

Items which are yellow identify either instances where

1. the test data is too noisy to interpret the characterization data set,
2. testing for this characteristic was not performed and MCST is not satisfied that the flight data sets will be transparent to this effect, or
3. test data indicates that the PFM L1B data product will not meet specification in terms of this characteristic.

In instances where a specification is not applicable to a band, the color used in the Chart is white.

In some instances the data set for a band is expected to generally meet the requirements, but there are some channels which are not within that specification. These cases are identified with channels numbers within the green cell that indicate which channels are not within specification. In the case of polarization, the requirement is polarization at a particular scan angle. The format here is scan angle first and channel number second.

IFOV

SBRS has submitted a waiver for channel-to-channel uniformity, VJ50-W079. Band 5, channel 17 (soft); Band 7, all bands marginal (virtually all laboratory data for the SWIR bands was noisy or saturated on PFM, so it is difficult to distinguish between sensor characterization performance failing to meet specification and merely inadequate test data to know the characteristic); Band 21 (test related) and Band 23 (marginal).

Co-Registration

SBRS has submitted Waiver WV081 for this characterization. The instrument failed to meet specification requirements for Spectral and Registration for one or more channels in Bands 3, 4, 5, 7, 12, 21, 27, 28, 29, 30, and 32. Some of this error likely was electronic cross-talk related, as each non-compliance involved at least one band which was impacted by electronic cross-talk. The MCST estimate is that these non-compliances will be transparent in the flight data set. Band 21 is marked yellow because it was not tested, due to low band gain characteristics.

Modulation Transfer Function

SBRS has submitted Waiver WV087 for this characterization. The bands identified in the Waiver all were impacted by electronic cross-talk. The cross-talk was minimized with a Space-viewing Analog Module resistor check, but no additional data has been obtained. This characteristic will be impacted by transient response characteristics.

Transient Response

SBRS has submitted a Waiver WV054 where they indicate that the sensor fails for all bands except Band 30. For Bands 20 to 30, these test data sets may have been impacted by electronic cross-talk.

Spectral

Relative Spectral Response In-band Measurements

The SBRS spectral response characteristics do not fully conform to specifications. This is documented in Waiver WV075. These non-compliances mainly are in center wavelength, band width and filter edge-range. Mainly these are minor. Actual use of the RSR will invalidate concerns with these non-compliances we expect.

The instrument used in testing in-band RSR has a slit function which did not fill the MODIS focal planes. Most bands were not well measured for the end channels, because the Spectral Measurement Assembly had a "smile" shape to the output slit function. The end channels for most bands were synthesized from the central channels for each band. This effect was well understood and the in-band RSR are considered well known. The uncertainty of the sensor specification for center wavelength does not correspond to that desired for the longest wavelength cloud bands (Band 33-36), so these are marked yellow. Also a light leak from Band 31 into Bands 32-36 contaminates the RSRs for these bands. Band 7 is yellow because the measurement saturated for this band.

Relative Spectral Response Out-of-band Measurements

SBRS submitted Waiver 063A to identify out-of spectral band compliance concerns.

The out-of-band measurements for Bands 27-36 are either not useful or were not performed on PFM. These values have been borrowed from the FM1 measurements and applied to PFM. This is expected to be a highly reliable assumption.

Optical Cross-talk

The blocking filters for the SWIR were not designed to extend across the complete sensitivity range of the SWIR detectors. The SWIR detectors for PFM had a longer wavelength cut-off than anticipated. Consequently, the SWIR bands have some sensitivity to thermal signals out to about 5.4 micrometers. This sensitivity is least for Band 7. The Bands 32 - 36 receive some signal from Band 31 due to a light leak.

Radiometric

NE δ I/NE δ T/SNR

SBRS submitted a Waiver 073 for SNR. Bands 7 and 36 were identified as not meeting SNR for all channels, and this is mainly related to measurement difficulties.

Polarization

SBRS submitted a Waiver for polarization, Waiver WV055. The polarization measurements were obtained with a Polarization Source Assembly and a reflection between the PSA and MODIS (likely to be at the first dichroic, D1). Consequently the residual polarization was determined by a Fourier extraction technique of the PSA test data. SNR for Bands 2 and 5 was too low to interpret this data. Residual polarization for Band 8 exceeds the desired amount (0.20), but there is no instrument specification for this band. The sensor is more polarization sensitive generally for the scan angles of 45 degrees. The specification does not extend to angles greater than 45 degrees. Bands 17 and 19 demonstrate greater residual polarization in the mirror side 1 data set than in the mirror side 2 data set.

RVS

1. These values are obtained using the characteristics of the fixed optics and a set of infrared s and p state polarized reflectance values from National Physical Laboratory measurements of PFM scan mirror witness samples. The characteristics of the PFM fixed optics are taken to be identical to those of the FM1 fixed optics. The FM1 fixed optics characteristics are inferred from an ambient high bay measurement of the FM1 RVS combined with NPL measurements of the FM1 scan mirror witness samples.
2. The use of a deep space scan to determine on-orbit the PFM RVS has been investigated. Our current understanding is that this data set will be helpful in validating the RVS for the Bands 33-36 at large scan angle.

Electronic Cross-talk

1. Data during the PFM Thermal Vacuum testing for Bands 5 - 7 and 20 - 30, including Band 26, were contaminated with electronic cross-talk. A fix was applied by changing resistors in the Space-viewing Analog Module electronics. No test data was obtained to verify the extent that this effect is reduced for PFM

Out-of-Family

The sensor meets linearity specification requirements. The SBRS memo documenting this performance is PL3095-O6399.

In this matrix, linearity is interpreted in the context of which channels within a band have a linearity characteristic which is different from that of the other channels within that band. In MCST terminology, we have called this characteristic, Out-of Family Channels. In the Reflected Solar Bands, we carry the calibration coefficients in the final product only on a band basis. Out-of-family behavior is handled as a correction within the dn^* computation. The calibration algorithms are designed to correct for out-of-family behaviors.

Dynamic Range

SBRS Waiver for dynamic range is provided in Waiver WV077. The Band 32 out of specification related to the fire band detection. MCST analysis indicates possible saturation at radiances below $0.9 L_{\max}$ for Bands 5 and 6. The data set showing this behavior was acquired before the electronic cross-talk was corrected, so we have no definitive knowledge for this characteristic.

Uncertainty

The SBRS Waiver on (absolute) radiometric accuracy is Waiver WV078 and WV062. these waivers are for the reflected solar bands. There are no waivers for the thermal emissive bands.

The reflected solar bands all are colored yellow because there are no measurements for the reflectance factor calibration product. The thermal emissive bands are indicated as green or yellow based on the analysis performed in conjunction with the electronic cross-talk repair studies.

References

A general reference for this material is "Specification Compliance and Calibration Data Books, Part IX - PFM, Compliance Matrix, " SBRS, Contract No. NAS5-30800, CDRL 222, May 1997.

Spatial

IFOV -- MCST Call # M0624, "PFM Spatial Performance Summary," F. Adimi, March 16, 1998

Co-Registration -- MCST Call # M0624, "PFM Spatial Performance Summary," F. Adimi, March 16, 1998

Modulation Transfer Function -- MCST Call # M0624, "PFM Spatial Performance Summary," F. Adimi, March 16, 1998

Transient Response -- MCST Reflected Solar Band Workshop February 11-12, 1999, Section IX, Scene Correction for Stray Light Contamination (Scattered Light Image Restoration Processing)

Spectral

Relative Spectral Response In-band Measurements

MODIS (MCST) Thermal Emissive Band Workshop, Miami, Fl, February 4-5, 1999, Section 7 PFM Relative Spectral Response T. Dorman and G. Godden.

Relative Spectral Response Out-of-band Measurements

MODIS (MCST) Thermal Emissive Band Workshop, Miami, Fl, February 4-5, 1999, Section 7 PFM Relative Spectral Response, T. Dorman and G. Godden.

Optical Cross-talk

1. MODIS Reflective Band Characterization and Algorithm, MCST Workshop, August 26-27, 1997, Stray Light and Crosstalk, Other PFM Instrument Characteristics, E Knight.
2. MODIS (MCST) Thermal Emissive Band Workshop, Miami, Fl, February 4-5, 1999, Section 10 Review of B31 Leaks into Bands 32-36, G. Godden.

Radiometric

NE δ I/NE δ T/SNR

Polarization

MCST Memo numbers on this topic are:

1. M0626 "PFM Polarization Results", C. Merrow, TBD, 1999
1. M0627 "PFM Polarization Analysis-Summary List of Memos", C. Merrow, TBD, 1999

RVS

1. The NPL measurements of the scan mirror witness samples was provided on November 24, 1998 in an attachment to an electronic mail message to godden@mcst.gsfc.nasa.gov from Nigel.Fox@NPL.co.uk.
2. Discussion on the utility of the deep space scan for MODIS PFM RVS is contained in MODIS (MCST) Thermal Emissive Band Workshop, Miami, FL, February 4-5, 1999, Section 13 Deep Space Scan RVS Retrieval by G. Godden and C. Moeller.

Electronic Cross-talk

1. A Report on the Laboratory Testing and Status of a Hardware fix for Electronic Cross-talk and a Review of Principle Testing Options MODIS PFM, B. Guenther, Version 1.0, 14 August 1998.
2. Red Team Review of Electronic Cross-talk, MCST Presentation, July 9 - 10, 1998.

Out-of-Family

The infrared out-of-family channels are documented in the Infrared Workshop, Madison, September 11 - 12, 1997, Section 2.0, Summary of Test Data and Data Analysis, G. Godden.

Dynamic Range

This information is describe in MCST Call #M0625, Saturation of the PFM Reflective Band Detectors, G. Fireman, April 13, 1999.

Uncertainty

The uncertainty for the thermal emissive bands is documented in "White Paper on Options for MODIS PFM Calibration," Version 2.2, B. Guenther, November 2, 1998.